National Climatic Data Center

DATA DOCUMENTATION

FOR

DATA SET 9651 (DSI-9651)

Hourly Precipitation Data Rainfall Event Statistics

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1. Abstract: Background: This data set represents a compilation of a set of statistics summarizing nationwide hourly precipitation data for 3,225 stations in the continental United States, Alaska, Hawaii, and Puerto Rico. This work was originally requested in 1986 by the U.S. Environmental Protection Agency, Office of Toxic Substances, Exposure Evaluation Division and performed by the National Climatic Data Center. The main objectives of the work done in 1986 were to provide parameters useful in estimation procedures for water budgets including infiltration, run off, evaporation, and ground water recharge. The major applications expected were engineering estimates of pollutant transport, especially leaching through soils. In 1992, Perrich (1992) acquired these data and published selected statistics as a storm event reference book. The intended application for this book was to provide rainfall information necessary to satisfying the U.S. EPA Storm Water Permitting Program under the National Pollution Discharge Elimination System.

A total of 26 long-term monthly rainfall statistics was computed from hourly precipitation data. These statistics are described in detail by Steurer and Nold (1986). Generally, the statistics included wet and dry day counts and storm frequencies, depths, intensities, and durations. Storm event statistics are to be applied to continuous-time stochastic modeling as described by Eagleson (1978). Wet versus dry day statistics are for application of discrete-time models as described by Richardson (1981) and Nicks (1975).

Method: Software was developed by at NCDC that reads data from Hourly Precipitation Data (DSI-3240) available at NCDC. The software computed a set of 26 rainfall statistics for those stations that met a selection test. The station selection criteria required a station to have at least 10 years of data during the period 1948 through 1983 (At least 10 Januaries, 10 Februaries, etc.). If more than 9 days in a month had missing or undefined hourly data, that month was excluded from processing. These requirements led to the selection of a set of 3,225 stations for which rainfall statistics were derived.

Hourly Precipitation Data Resolution: Hourly precipitation data are recorded at primary, secondary, and cooperative observation stations operated by the National Weather Service and Federal Aviation Administration. Two distinct types of rain gauges are used to record hourly precipitation. A weighing or recording gauge measures hourly precipitation to the nearest hundredth of an inch. Fischer-Porter gauges record hourly precipitation to the nearest tenth of an inch. Since the 1960's, many Fischer-Porter gauges have been phased into the network, many times replacing the weighing rain gauges.

Due to the difference in data resolution between the Fischer-Porter and weighing rain gauges, separate statistics were generated for the period of time when each gauge type was in operation. In addition, a combined gauge statistic was also generated. This resulted in 78 monthly statistics (26 statistics times 3 gauges categories) for each station.

Occasionally an hourly rain gauge will develop mechanical problems resulting in the loss of the exact time when precipitation occurred and/or the amount of precipitation. When the exact beginning and ending times of precipitation are unknown, but the amount is known, the precipitation total is said to have been accumulated from the beginning of the unknown period. When the amount of precipitation is unknown, data are said to be missing from the beginning of the unknown period.

Hours which contain such missing or accumulated data were excluded from processing for storm durations and rates. However, accumulated totals were added into the monthly mean precipitation total (Statistic 1) and also kept as a separate statistic (Statistic 20). If a day had one or more hours designated missing or accumulated, the day was counted as uncertain (Statistic 18). The entire month was excluded from processing if there were nine or more uncertain days.

Rainfall Event Definitions: Storm events are defined by a total accumulation requirement together with rate or duration requirements. The general storm description used here is a total accumulation of at least 0.1 inches together with rates averaging at least 0.01 inches per hour. Each rainfall event accumulating less than 0.1 inches in a weighing gauge would not be called a separate storm but would be added into a low-level rain total (not observed at Fischer-Porter stations) and counted with the total monthly precipitation. In addition to storm event accounting, wet day versus dry day statistics were compiled for two definitions of wet day: total daily accumulation of 0.1 inches and 0.01 inches with the latter only applying to weighing rain gauges.

Statistics for each month are compiled separately even though this occasionally counts a storm bridging two months as two separate events. Accounting for a rainfall event begins in an hour when at least 0.01 inches is recorded. Subsequent hours are connected into the event whenever the rate remains greater than 0.01 inches per hour on the average. Implementation of this connection rule uses a ten-hour moving window for averaging. When the average falls below 0.01 inches per hour, the event ends. The ending hour is then identified as the one with last recorded rain. Thus the beginning and ending hour each contain measured rain, but some intermediate hours may contain none. The purpose of the ten-hour moving window is to establish partial equivalence between weighing gauges and Fischer-Porter gauges. An event is counted as storm only if at least 0.1 inches was measured and the beginning and ending hours could be identified.

This data set has been used historically to determine the data necessary for the U.S. EPA Storm Water Permitting Program under the National Pollution Discharge Elimination System. Other major applications are engineering estimates of pollutant transport, especially leaching through soils.

2. Element Names and Definitions:

The data are archived in a fixed length ASCII format. The total data volume is 24 megabytes. The data are sorted by the state number (ISTATE) as the primary key followed by station (ISTATN), gauge type (IGAGE), and statistic number (ISTNUM) as secondary keys.

Element	Type	Width	Start Column	End Column
ITYPE	Integer	1	1	1
ISTATE	Integer	2	2	3
ISTATN	Integer	4	4	7
IDIV	Integer	2	8	9
ISTNUM	Integer	2	10	11
IGAGE	Integer	1	12	12
RMON(1)	Real	7	13	19
RMON(2)	Real	7	20	26
RMON(3)	Real	7	27	33
RMON(4)	Real	7	34	40

RMON(5)	Real	7	41	47
RMON(6)	Real	7	48	54
RMON(7)	Real	7	55	61
RMON(8)	Real	7	62	68
RMON(9)	Real	7	69	75
RMON(10)	Real	7	76	82
RMON(11)	Real	7	83	89
RMON(12)	Real	7	90	96

ITYPE is an Integer variable that describes the type of station in regard to the rain gauge that was used by the station. Range of values and definitions are:

1 = weighing rain gauge station for entire period or record
2 = Fischer Porter rain gauge station for entire period of record
3 = Gauge type change sometime during period of record

ISTATE is an Integer variable that refers to the USA state code. The range of values is (01-99)

ISTATN is an Integer variable that refers to cooperative station number. Range of values is 0001-9999.

IDIV is an Integer variable that refers to the climate division number.

ISTNUM is an Integer variable that refers to the statistic number. Range of values is 01 through 26. The definitions of each equation and their associated dimensions are listed below:

01 - monthly mean precipitation total (inches)
02 - monthly mean of the average storm duration (hours)
03 - monthly mean number of storm events (dimensionless)
04 - monthly mean average storm depth (inches)
05 - monthly variance of the average storm depth (inches squared)
06 - monthly mean of the average storm intensity (inches/hour)
07 - monthly mean of the maximum hourly rainfall rate (inches)
08 - monthly mean of the maximum storm depth (inches)
09 - associated duration of statistic 08 (hours)
10 - monthly mean duration of the longest dry period (period between defined wet or flagged days) (days)
11 - monthly mean of the maximum storm duration (hours)
12 - associated depth of statistic 11 (inches)
13 - monthly mean number of wet days (>or= .10 inches) (dimensionless)
14 - monthly mean fraction of the wet days such that the previous day was also wet (>or= .10 inches) (dimensionless)
15 - monthly mean fraction of dry days such that the following day was wet (>or= .10 inches) (dimensionless)
16 - monthly mean of the average daily rainfall depth falling on wet days (>or= .10 inches) (inches)
17 - monthly variance of the average daily depth falling on wet days (>or= .10 inches) (inches squared)
18 - monthly mean of the number of days with 1 or more flagged hourly values (dimensionless)
19 - monthly mean of the total rainfall not reaching storm event classification (inches)
20 - monthly mean of the 'accumulated' (timing uncertain) total rainfall

(inches)
21 - monthly mean number of wet days (>or= .01 inches) (dimensionless)
22 - monthly mean fraction of the wet days such that the previous day was also wet (>or= .01 inches) (dimensionless)
23 - monthly mean fraction of dry days such that the following day was wet (>or= .01 inches) (dimensionless)
24 - monthly mean of the average daily rainfall depth falling on wet days (>or= .01 inches) (inches)
25 - monthly variance of the average daily depth falling on wet days (>or= .01 inches) (inches squared)
26 - total number of months of record (dimensionless)

IGAGE is an Integer variable that refers to the gauge type for each statistic. The range of values and definitions are:
1 = weighing rain gauge only statistic
2 = Fischer Porter gauge only statistic
3 = Combined gauge statistic

RMON is a Real one dimension array that contains 12 monthly statistics with RMON(1) corresponding to January, RMON(2) corresponding to February, etc.

3. Start Date: This data set represents a group of summary statistics. The beginning period of record used in generating these statistics varied per station but was usually 1948.

4. Stop Date: This data set represents a group of summary statistics. The ending period of record used in generating these statistics varied per station but was usually 1983.

5. Coverage: North America

a. Southernmost Latitude: 18N
b. Northernmost Latitude: 65N
c. Westernmost Longitude: 160W
d. Easternmost Longitude: 65W

6. How to Order Data:

Ask NCDC's Climate Services about the cost of obtaining this data set.
Phone: 828-271-4800
FAX: 828-271-4876
E-mail: **NCDC.Orders@noaa.gov**

7. Archiving Data Center:

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, NC 28801-5001
Phone: (828) 271-4800.

8. Technical Contact:

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Federal Building
151 Patton Avenue

Asheville, NC 28801-5001
Phone: (828) 271-4800.

9. Known Uncorrected Problems: There are no known uncorrected problems in this data set.

10. Quality Statement: All hourly precipitation data totals were processed through a series of quality checks to ensure that erroneous values would not be incorporated into the final monthly statistics. Rainfall amounts were redefined as missing and not included in the monthly statistics if they met at least one of the following conditions: (1) hourly totals which were greater than the statewide 100-year 24-hour rainfall, (2) accumulated totals that spanned days and were greater than the extreme monthly statewide rainfall total, and (3) accumulated totals which did not span days and were greater than the extreme daily statewide rainfall total.

The monthly statistics of maximum storm depth, intensity, and duration are for use in assessments to represent typical cases of large or persistent storms. These statistics should not be considered representative of maxima over periods of record for purposed of flood prediction. Similarly, the largest dry period statistic is intended to represent a typical long time window for moisture evaporation or chemical volatilization, but should not be assumed to provide for a measure of drought periods.

11. Essential Companion Datasets: The use of NCDC's Station History file (DSI-9767) is required in order to determine metadata on each station (name, location, elevation, etc.). This can be accomplished by comparing the station number in bytes 2 through 7 of this data set with the corresponding station number in the Station History data set.

12. References:

Eagleson, P.S., 1978: Climate, Soil, and Vegetation 2. The Distribution of Annual Precipitation Derived from Observed Storm Sequences. Water Resources Research 14, 5 pp.

Nicks, A.D., 1975: Stochastic Generation of Hydrologic Model Inputs. Ph.D. thesis U. of Oklahoma, Norman.

Perrich, J.E., 1992: The ESE National Precipitation Databook. Cahners Publishing Co., Des Plaines, Il., 686 pp.

Richardson, C.W. 1981: Stochastic Simulation of Daily Precipitation, Temperature, and Solar Radiation. Water Resources Research 17, 1, 182-190.

Steurer, P.M. and A. Nold, 1986: Climate Data Summaries from Hourly Precipitation Data and State Climatic Divisions. Unpublished NCDC Technical Document, 5 pp.